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European Patent Office

SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 00 93 4818

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	US 3 822 720 A (SOUZA A) 9 July 1974 (1974-07-09) * column 2, line 52 - column 4, line 42 * * figures 1-7 *	1-11 12	F16K15/14 F16K15/20 F16K7/02 F16K7/04 F16K7/07 B60C29/00 B32B3/24
X	US 4 240 630 A (HOFFMAN ALLAN C) 23 December 1980 (1980-12-23) * column 1, line 11-15 * * column 11, line 7 - line 41 * * figures 24-27 *	1-3,8-11	
X	BE 387 674 A (MARCEL TINLOT) 31 May 1932 (1932-05-31) * the whole document *	1,8-11	
X	US 4 426 062 A (BOWRON HOWARD J) 17 January 1984 (1984-01-17) * column 1, line 64 - column 2, line 19 * * figure 3 *	1,8-11	
X	WO 83 02320 A (TAYLOR LIONEL IVOR ALFRED) 7 July 1983 (1983-07-07) * page 2, line 23 - page 3, line 18 * * figure 1 *	1,8-11	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F16K
X	WO 98 01689 A (FICO TRANSPAR SA ;MOTA LOPEZ MIGUEL (ES); ELVIRA PERALTA JUAN JESU) 15 January 1998 (1998-01-15) * abstract; figures 1-5 *	1,8-11	
X	EP 0 167 274 A (PALMER PAUL ;CARTWRIGHT GARY ERNEST (GB)) 8 January 1986 (1986-01-08) * page 6, line 8 - page 7, line 22 * * page 9, line 1 - line 19 * * figure 1 *	1,4,9	

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
MUNICH	26 June 2002	Awad, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 93 4818

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-06-2002

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 3822720 A	09-07-1974	NONE		
US 4240630 A	23-12-1980	JP	1444989 C	30-06-1988
		JP	54139123 A	29-10-1979
		JP	62042194 B	07-09-1987
		JP	1732260 C	17-02-1993
		JP	4011231 B	27-02-1992
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		US	4327912 A	04-05-1982
BE 387674 A		NONE		
US 4426062 A	17-01-1984	NONE		
WO 8302320 A	07-07-1983	EP	0096707 A1	28-12-1983
		WO	8302320 A1	07-07-1983
WO 9801689 A	15-01-1998	ES	2130947 A1	01-07-1999
		AU	3033997 A	02-02-1998
		WO	9801689 A1	15-01-1998
EP 0167274 A	08-01-1986	EP	0167274 A2	08-01-1986

iii) the valve is complicated in operation and thus in operation may be susceptible to failure.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm in the form of a generally conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself at least initiates closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

According to another aspect of the present invention there is provided a non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

at least two valve diaphragms being axially spaced along and connected across the fluid passageway, each of

the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of either of the axially spaced diaphragms deflects said diaphragm to expose the corresponding aperture and allow fluid to flow through the passageway and across said diaphragm toward the fluid outlet only.

Typically the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle which is designed to be retractably received within the passageway.

Generally the fluid is a liquid such as petrol and the non-return valve serves to prevent a reverse flow or escape of vapours.

Preferably the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle. For example, the non-return valve is configured to fit to a petrol tank.

According to a further aspect of the present invention there is provided a non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid

passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

Generally the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned. Alternatively the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

Preferably each of the diaphragms is formed integral with the corresponding valve body. More preferably the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

According to yet another aspect of the present invention there is provided a non-return valve comprising:

a valve body including a passageway which defines an inlet and an outlet, the passageway being adapted to receive means for actuating the valve;

at least two valve diaphragms being axially spaced along and connected across the passageway, each of the diaphragms including a collapsible aperture and being

constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas engagement of said actuating means with at least one of the diaphragms exposes its corresponding aperture and allows passage across said diaphragm toward the fluid outlet only.

Generally said actuating means is a fluid nozzle which is retractably inserted into at least one of the collapsible apertures to permit a flow of fluid across the corresponding diaphragm via the fluid nozzle.

Preferably the valve membrane is formed integral with the valve body.

Typically the valve membrane is constructed of a mouldable polymeric material. More typically the polymeric material is an elastomer such as a rubber material. Alternatively the polymeric material is a nylon-based material.

Preferably the valve body is configured to retrofit to an existing valve stem. Alternatively the valve body is designed to be sealably inserted into a flow line.

Generally the fluid is water or compressed air.

According to yet a further aspect of the present invention there is provided a membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm in the form of a generally conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself at least initiates closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

2. A non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

at least two valve diaphragms being axially spaced along and connected across the fluid passageway, each of the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent

fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of either of the axially spaced diaphragms deflects said diaphragm to expose the corresponding aperture and allow fluid to flow through the passageway and across said diaphragm toward the fluid outlet only.

3. A non-return valve as defined in claim 1 or 2 wherein the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle which is designed to be retractably received within the passageway.

4. A non-return valve as defined in claim 3 wherein the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle.

5. A non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the

aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

6. A non-return valve as defined in claim 5 wherein the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned.

7. A non-return valve as defined in claim 5 wherein the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

8. A non-return valve as defined in any one of claims 5 to 7 wherein the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

9. A non-return valve comprising:

a valve body including a passageway which defines an inlet and an outlet, the passageway being adapted to receive means for actuating the valve;

at least two valve diaphragms being axially spaced along and connected across the passageway, each of the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas engagement of said actuating means with at least one of the diaphragms exposes its corresponding aperture and allows passage across said diaphragm toward the fluid outlet only.

10. A non-return valve as defined in claim 10 wherein said actuating means is a fluid nozzle which is retractably inserted into at least one of the collapsible apertures to permit a flow of fluid across the corresponding diaphragm via the fluid nozzle.

11. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is formed integral with the valve body.

12. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is constructed of a mouldable polymeric material.

13. A non-return valve as defined in any one of the preceding claims wherein the valve body is configured to retrofit to an existing valve stem.

14. A non-return valve as defined in any one of the preceding claims wherein the valve body is designed to be sealably inserted into a flow line.

15. A membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture

and allow fluid to flow across the membrane in said one direction only.

16. A membrane as defined in claim 15 wherein the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference fp12836	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International Application No. **PCT/AU00/00659**	International Filing Date *(day/month/year)* 14 June 2000	Priority Date *(day/month/year)* 15 June 1999

International Patent Classification (IPC) or national classification and IPC

Int. Cl. [7] F16K 15/14, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

Applicant

IP.ONE PTY LTD et al

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   [X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of **8** sheet(s).

3. This report contains indications relating to the following items:

I	[X]	Basis of the report
II	[ ]	Priority
III	[ ]	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	[ ]	Lack of unity of invention
V	[X]	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	[ ]	Certain documents cited
VII	[ ]	Certain defects in the international application
VIII	[ ]	Certain observations on the international application

Date of submission of the demand	Date of completion of the report
15 January 2001	26 June 2001
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **DAVID LEE** Telephone No. (02) 6283 2107

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU00/00659

I. Basis of the report

1. With regard to the **elements** of the international application:*

- [ ] the international application as originally filed.
- [X] the description. pages 1, 6-16, as originally filed.
  pages 2, received on 18 June 2001 with the letter of 18 June 2001
  pages 3-5, received on 9 April 2001 with the letter of 9 April 2001
- [X] the claims, pages , as originally filed,
  pages , as amended (together with any statement) under Article 19,
  pages 17, received on 18 June 2001 with the letter of 18 June 2001
  pages 18-20, received on 9 April 2001 with the letter of 9 April 2001
- [X] the drawings, pages 1-15, as originally filed,
  pages , filed with the demand,
  pages , received on with the letter of
- [ ] the sequence listing part of the description:
  pages , as originally filed
  pages , filed with the demand
  pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is

- [ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b))
- [ ] the language of publication of the international application (under Rule 48.3(b)).
- [ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

- [ ] contained in the international application in written form.
- [ ] filed together with the international application in computer readable form.
- [ ] furnished subsequently to this Authority in written form.
- [ ] furnished subsequently to this Authority in computer readable form.
- [ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- [ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. [ ] The amendments have resulted in the cancellation of:
   - [ ] the description. pages
   - [ ] the claims. Nos.
   - [ ] the drawings, sheets/fig.

5. [ ] This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-13	YES
	Claims		NO
Inventive step (IS)	Claims	1-13	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-13	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

US 3822720, WO 83/02320, WO 98/01689, GB 2298027

<u>Novelty & Inventive step - Claims 1-13</u>

The citations disclose similar "duckbill", resilient non-return valves. However, they do not disclose the combination of features of
- a conical shaped diaphragm having a collapsible aperture located at or near its apex, with
- the application of pressure, exceeding atmospheric pressure and that on the high pressure side, to an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

These are clearly distinguishing features.

Hence, claims 1-13 are novel and have an inventive step.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 December 2000 (21.12.2000)

PCT

(10) International Publication Number
WO 00/77429 A1

(51) International Patent Classification[7]: F16K 15/14, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

(21) International Application Number: PCT/AU00/00659

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(71) Applicant *(for all designated States except US)*: **IP.ONE PTY. LTD.** [AU/AU]; Level 2, 154 Elizabeth Street, Sydney, NSW 2000 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **HORTON, David** [US/AU]; 35 Alexandra Street, Drummoyne, NSW 2047 (AU).

(74) Agent: **GRIFFITH HACK**; 168 Walker Street, North Sydney, NSW 2001 (AU).

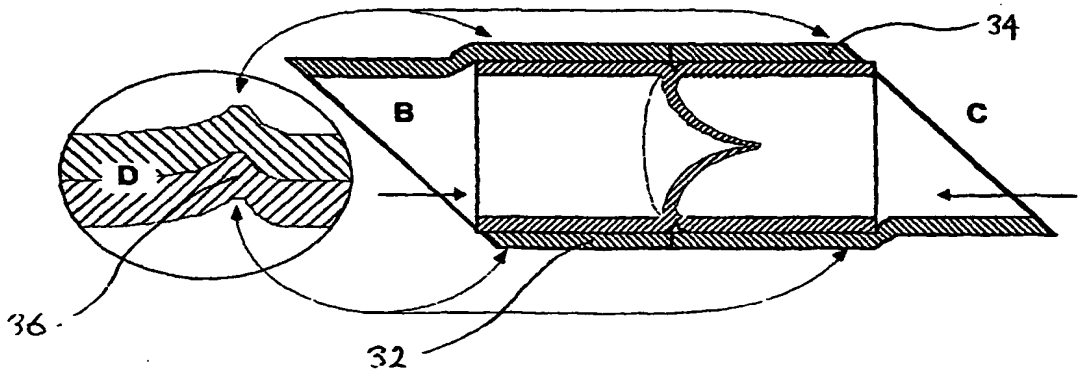
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A NON-RETURN VALVE



(57) Abstract: A non-return valve (10), typically of commonly called duckbill valve shape, comprising a valve body (12) and a valve membrane (14). The valve body (12) is generally tubular and includes an elongate passageway (16) with inlet (18) and outlet (20) at opposing ends. The valve membrane (14) is of a generally conical-shaped diaphragm formed integrally with the valve body (12). The diaphragm (14) has a collapsible opening or aperture (22) located at or adjacent the cones apex. The conical diaphragm (14) is oriented with its apex pointing downstream. The resiliently flexible material from which the diaphragm (14) is constructed, ensures that the diaphragm (14) in a collapsed condition obstructs or closes the aperture (22) to prevent fluid flowing in a reverse direction, i.e. backflow towards the inlet. Pressurisation of fluid within the passageway (16) on the inlet (18) side of the diaphragm (14), deflects the diaphragm to open the aperture (22) so that fluid can flow through the passageway from the inlet (18) to the outlet (20) only. A membrane permeable in one direction only can also be made from a panel or sheeting incorporating many such collapsible non-return duckbill valves on the surface of the panel or sheet.

WO 00/77429 A1

A NON-RETURN VALVE

FIELD OF THE INVENTION

The present invention relates generally to a non-return valve such as that used on a pneumatic tyre, and a membrane being permeable in one direction only.

BACKGROUND TO THE INVENTION

Non-return valves are common in industrial and domestic applications and are particularly prolific on pneumatic tyres. Figure 1 illustrates the various components of a conventional pneumatic non-return valve 1. The valve 1 comprises an inlet casing 2 which is screw threaded within a valve stem of a tyre (not shown). The inlet casing 2 houses a shaft 3 along which a valve member 4 slidably moves. The valve member 4 is biased against a seat 5 of the casing 2 under the force of a compression spring 6 so as to close the valve 1. A spring retainer 7 is connected to an end of the shaft 3 so as to retain the compression spring 6. Pressurisation of the non-return valve 1 releases the valve member 4 from the seat 5 to allow filling of the tyre.

The conventional pneumatic non-return valve 1 suffers from at least the following problems:

i) the valve 1 has a relatively large number of components which may require periodic servicing and maintenance;

ii) the valve 1 is expensive including relatively complex machined components; and

iii) the valve is complicated in operation and thus in operation may be susceptible to failure.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm in the form of a generally conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself at least initiates closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

According to another aspect of the present invention there is provided a non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

at least two valve diaphragms being axially spaced along and connected across the fluid passageway, each of

the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of either of the axially spaced diaphragms deflects said diaphragm to expose the corresponding aperture and allow fluid to flow through the passageway and across said diaphragm toward the fluid outlet only.

Typically the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle which is designed to be retractably received within the passageway.

Generally the fluid is a liquid such as petrol and the non-return valve serves to prevent a reverse flow or escape of vapours.

Preferably the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle. For example, the non-return valve is configured to fit to a petrol tank.

According to a further aspect of the present invention there is provided a non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid

passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

Generally the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned. Alternatively the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

Preferably each of the diaphragms is formed integral with the corresponding valve body. More preferably the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

According to yet another aspect of the present invention there is provided a non-return valve comprising:

a valve body including a passageway which defines an inlet and an outlet, the passageway being adapted to receive means for actuating the valve;

at least two valve diaphragms being axially spaced along and connected across the passageway, each of the diaphragms including a collapsible aperture and being

constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas engagement of said actuating means with at least one of the diaphragms exposes its corresponding aperture and allows passage across said diaphragm toward the fluid outlet only.

Generally said actuating means is a fluid nozzle which is retractably inserted into at least one of the collapsible apertures to permit a flow of fluid across the corresponding diaphragm via the fluid nozzle.

Preferably the valve membrane is formed integral with the valve body.

Typically the valve membrane is constructed of a mouldable polymeric material. More typically the polymeric material is an elastomer such as a rubber material. Alternatively the polymeric material is a nylon-based material.

Preferably the valve body is configured to retrofit to an existing valve stem. Alternatively the valve body is designed to be sealably inserted into a flow line.

Generally the fluid is water or compressed air.

According to yet a further aspect of the present invention there is provided a membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible

aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture and allow fluid to flow across the membrane in said one direction only.

Generally the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to facilitate a better understanding of the nature of the present invention several embodiments of a non-return valve and a membrane being permeable in one direction only will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a general assembly of a conventional pneumatic non-return valve;

Figure 2 illustrates three stages in the general assembly of a non-return valve according to one embodiment of the invention;

Figure 3 is a general assembly of another embodiment of the invention suitable for use with irrigation tubing;

Figure 4 is a general assembly of a further embodiment of a non-return valve of the invention suitable for use in pneumatic tyres;

Figure 5 is an assembly of a non-return valve of yet another embodiment of the invention suitable for tubeless pneumatic tyres;

Figure 6 is a general assembly of a non-return valve of another aspect of the invention;

Figure 7 is an elevational and part cutaway view of a tool suitable for moulding of the non-return valve;

Figure 8 is a part cutaway together with an enlarged view of the tool of Figure 7;

Figure 9 is sectional views of the tool of Figures 7 and 8;

Figure 10 illustrates three embodiments of a non-return valve according to a further aspect of the invention;

Figures 11A to 11C depict another embodiment of this aspect of a non-return valve incorporated in a quick connect coupling of a hydraulic line;

Figure 12 is an exploded sectional view of various components of the non-return valve of Figures 11A to 11C; and

Figure 13 is a sectional representation of a membrane according to yet another aspect of the invention being permeable in one direction only.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figures 2 to 5 there are various embodiments of a non-return valve shown generally as 10 constructed in accordance with one aspect of the invention. For ease of reference and in order to avoid repetition like components have been designated with the same reference numerals.

In each example the non-return valve 10 comprises a valve body 12 and a valve membrane 14. The valve body 12 is generally tubular and includes an elongate passageway 16 having an inlet and an outlet defined at its opposing ends 18 and 20, respectively.

The non-return valve 10 of these embodiments is moulded from a polymeric material, preferably an elastomer such as rubber or a nylon-based material. The selection of the appropriate material for the valve 10 will be obvious to one skilled in the art without trial and experimentation. The valve membrane 14 is in the form of a conical-shaped diaphragm formed integral with the tubular valve body 12. The diaphragm 14 is configured as a generally conical-shaped element having a collapsible opening or aperture 22 located at or adjacent its apex. The conical diaphragm 14 is orientated with its apex in a downstream flow direction. The resiliently flexible material from which the diaphragm 14 is constructed ensures that the diaphragm 14 in a collapsed condition obstructs or closes the aperture 22 to prevent fluid flowing in a reverse direction toward the inlet 18. On the other hand, pressurisation of fluid within the passageway 16 on the inlet side of the diaphragm 14 deflects the diaphragm 14 to expose the aperture 22. Thus, with the aperture 22 exposed fluid is allowed to flow through the passageway 16 from the inlet 18 to the outlet 20 only.

Figures 2 to 5 depict installation of variations on the non-return valve 10 in various applications. The non-return valve 10 of Figure 2 is flared at its inlet 18 and is configured to seat within an internally and externally threaded nipple 24. An externally threaded conduit 26 and an internally threaded conduit 28 then threadably engage the respective male/female threaded nipple 24 so as to form a mated union shown generally as 30. The mated union 30 is designed so that sufficient compression is applied to the valve body 12 to seal it within the nipple 24. It will be appreciated that the non-return valve 10 can be adapted to suit any standard and pre-existing plumbing components such as the threaded nipple 24 and conduits 26 and 28 described.

Figure 3 shows another non-return valve 10 which in this embodiment is suitable as a "slip on union" such as that used with adjacent lengths of irrigation tubing such as 32 and 34. In this example the tubing 32 and 34 is expanded over respective ends of the tubular valve body 12. As indicated in enlarged detail one or more barbs such as 36 may be included in the valve body 12 to both provide firm engagement with and enhance the seal between the tube 32 and 34 and the valve body 12. Fitting of the polyethylene tube 32 or 34 to the valve 10 may involve heating of the tubing to improve its pliability. The tubing 32 or 34 will naturally cool under ambient conditions after it has been slipped over the valve body 12.

Figure 4 shows another variant of the non-return valve 10 which may be substituted for the conventional pneumatic non-return valve 1. In this embodiment the valve body 12 is provided with an external thread 38 for securing the valve 10 within a stem 40. The stem 40 is preferably that of the conventional pneumatic non-return valve 1.

Figure 5 shows installation of the non-return valve 10 of Figure 4 in a pneumatic tyre of a tubeless configuration. The valve stem 40 is located in a conventionally fabricated rubber casing 42 which includes an annular channel 44 in which a wheel rim is seated. Alternatively, the rubber casing may be formed integral with the non-return valve 10. In this example the height of the rubber casing 42 or valve body 12 is reduced so that it is stiffened for insertion into the wheel rim. Furthermore, an inner lip 46 of the casing or valve body 12 is reduced in sectional size and profile so as to assist in seating of the channel 44 about the rim.

Figure 6 illustrates one example of a non-return valve 50 according to another aspect of the invention. The non-return valve 50 is similar in construction to those described above with a tubular valve body 52 and a conical-shaped diaphragm 54. The tubular body 52 includes a passageway 56 defining an inlet and outlet 58 and 60 either side of the diaphragm 54. The diaphragm 54 is formed integral with the valve body 52 and fabricated or moulded from resiliently flexible polymeric materials.

In this particular construction of the non-return valve 50 an annular flange 62 is provided at the inlet end of the valve body 52. The valve body 52 fits about a filler tube 64 of a fuel tank and the flange 62 provides a seal against a panel 66 of a motor vehicle (not shown). In use, a filler nozzle 68 is retractably received within the valve 10 so as to deflect the diaphragm 54 to permit a flow of gasolene into the fuel tank via the nozzle 68. Thus, the diaphragm 54 is resiliently deformed so as to expose a collapsible opening 70 through which the nozzle 68 passes. Importantly, the diaphragm 54 forms about the nozzle 68 to prevent the escape of gasoline vapours from the filler tube 64 or tank. When the nozzle is retracted from the valve 50 the valve membrane 54 returns to its collapsed condition wherein it obstructs or closes the collapsible opening 70. Thus, in the collapsed condition fuel vapour is prevented from escaping the tank or flowing in a reversed direction toward the inlet 58.

Figures 7 to 9 schematically illustrate a moulding tool which is appropriate for forming a non-return valve such as 10 described above. The tool shown generally as 80 is designed for use in a conventional injection moulding machine.

The tool 80 includes two (2) mutually engagable die sections 82 and 84. Each of the die sections 82 and 84 includes a shaft and a collar 86/88 and 90/92, respectively. The shaft 86 and collar 88 of one of the die sections 82 is machined together whereas the collar 92 is allowed to rotate on the shaft 90 of the other die section 84. This allows for removal of the tool 80 from the external thread 38 of the non-return valve 10 of this example. The part cut-away view of Figure 7 shows in some detail the internal geometry of the tool 80 which defines an internal cavity 94 for injection of the polymeric material. Importantly, a relatively thin projection 96 is connected to the shaft 86 and extends across the apex of the resultant valve 10. This projection 96 thus forms or defines the collapsible opening or aperture 22 of the valve 10.

Figure 8 illustrates the tool 80 of Figure 7 in a retracted position with the die section 82 removed from the injected valve 10. The collar 92 of the other die section 84 is then rotated so as to release the injected valve 10 from the tool 80. As the injected polymer cools the membrane or diaphragm 14 is released from the shaft 90 of the other die section 84. However, the shaft 90 of the other die section 84 may also include a plunger or other means to assist or aid in removal of the injected valve 10. Figure 8 also depicts injection and relief ports 98 and 100, respectively, which provide a flow of polymer to the die cavity 90. One of the die sections 82 or 84 may also include a dowel pin 102 for interengagement of the die sections 82 and 84. The injector ports 98 provide a discriminate point for polymer to be injected uniformly throughout the cavity 90 of the tool 80. The relief ports 100 allow an even flow and distribution of injected polymer throughout the die cavity 90.

As shown in Figure 10 there are three embodiments of a further aspect of a non-return valve 100 comprising a bank or series of non-return valves such as 120 and 140 of similar construction coupled to one another. The overall non-return valve 100 is thus of a "fail-safe" configuration. For ease of reference and in order to avoid repetition like components have been designated with the same reference numerals.

In this particular construction of the fail-safe non-return valve 100 each of the series of non-return valves such as 120 and 140 includes a valve body such as 160 or 180 together with a corresponding valve membrane such as 200 or 220. The valve bodies 160 or 180 are generally tubular and moulded together with the corresponding diaphragm 200 or 220 which is configured as a generally conical-shaped element. Importantly, the diaphragm 200 or 220 includes a collapsible aperture 240 or 260 formed at its apex. The conical diaphragm 200 or 220 is orientated with its apex in a downstream flow direction.

In this example the collapsible diaphragms 200 and 220 are moulded from a polymeric material, preferably an elastomer such as rubber or a nylon-based material. The particular shape of the diaphragm 200 or 220 together with the resilient material from which it is constructed ensures that the diaphragm 200 or 220 in a collapsed condition obstructs or closes the aperture 240 or 260 to prevent fluid flowing in an upstream direction. On the other hand, with pressure imposed on an upstream side of either of the diaphragms 200 or 220 said diaphragm is deflected to expose the corresponding collapsible aperture 240 or 260. Thus, with the collapsible apertures 240 or 260 exposed fluid is

allowed to flow in a downstream direction through the fail-safe non-return valve 100.

Figure 10 depicts two configurations of the fail-safe non-return valve 100 where either two non-return valves such as 120 and 140 are nested within one another or are of substantially the same configurations and merely abut one another. In the "nested" embodiment of the fail-safe non-return valve 100 the outer body 160 of the outer valve 120 is internally threaded and designed to engage the inner body 180 of the inner valve 140. In the other embodiment, adjacent valve bodies 160 and 180 are aligned with one another and may together be housed or contained within a valve casing (not shown). In both cases the valve diaphragms such as 200 and 220 are oriented such that their respective collapsible apertures 240 and 260 are aligned and coaxial with one another. An internal bore of the valve bodies 160 and 180 together defines a fluid passageway 280 of the non-return valve 100 including a fluid inlet 300 and outlet 320.

Figures 11A to 11C illustrate another aspect of a non-return valve according to the invention which in this embodiment is designed to be incorporated in a quick connect coupling shown generally as 500 of a hydraulic line or hose 520. The hydraulic coupling 500 is designed to threadably engage a valve casing 540 in which another embodiment of a non-return valve 1000 is mounted. For ease of reference and in order to avoid repetition components of this non-return valve 1000 which are similar to the non-return valve 10 or 100 described above are designated with an additional "0". For example, the diaphragms are designated as 200 and 2200.

In this application the valve diaphragms 200 and 220 are actuated not by fluid pressure but rather via a fluid nozzle which in this example is in the form of a fluid injector 560 which is connected to the hydraulic hose 520 via barbs 580 formed about a periphery of the injector 560. Figures 11A to 11C show the sequential steps involved in connecting the quick coupling 500 to the casing 540. The injector coupling 500 is initially slid longitudinally along the injector 560 until it abuts an annular flange 600 formed about the injector 560. The injector 560 is then pressed into engagement with the diaphragms 2000 and 2200 so as to expose their corresponding collapsible apertures 2400 and 2600. The coupling 500 is progressively threaded onto the casing 540 so as to drive the injector 560 into engagement with the diaphragms 2000 and 2200. Thus, in this example, hydraulic fluid or the like which is contained in the casing 540 and any associated plumbing is allowed to flow to the flexible hose 520 upon connection of the quick coupling 500. The nozzle 560 thus serves as the means for actuating the valve 1000 of this particular aspect of the invention.

Figure 12 illustrates an exploded sectional view of the valve 1000 incorporated in the quick connect hydraulic coupling described. Each of the valve bodies 1200 and 1400 is designed to coaxially press-fit within the casing 540. Each body 1200 and 1400 includes an annular recess 620 being shaped complementary to and designed to be engaged by a corresponding ridge 640 formed circumferentially within an inner surface of the casing 540.

Figure 13 depicts one example of a membrane 1000' of another aspect of the invention. The membrane 1000' is permeable in one direction only and on a microscopic scale may be applied as a means of repairing a lung. The

membrane 1000' is multi-layered with a series of panels or blankets of collapsible diaphragms such as 2000' being formed alongside one another. In this embodiment each of the diaphragms such as 2000' includes a corresponding valve body 1600' which is formed integral with an adjacent valve body of an adjacent diaphragm. However, it should be appreciated that the membrane 1000' need not include this arrangement of valve bodies but rather may be limited to a panel or blanket of interconnected collapsible diaphragms. In any case the membrane 1000' functions along the same lines as the non-return valve 10 or 100 described above. That is, pressure imposed on an upstream side of the membrane 1000' deflects one or more of the diaphragms such as 2000' to expose its corresponding aperture 2400' to allow fluid to flow across the membrane 1000'. On the other hand, without a positive pressure imposed on the upstream side of the membrane 1000', the diaphragms such as 2000' are in a collapsed condition such that the collapsible apertures such as 2400' are closed to prevent the flow of fluid in a reverse direction across the membrane 1000'.

Now that several preferred embodiments of the various aspects of the present invention have been described in some detail it will be apparent to those skilled in the art that the non-return valve and permeable membrane have at least the following advantages:

(i) the non-return valve is relatively simple in construction;

(ii) the non-return valve is effective in operation relying on fluid pressure for opening, and valve membrane characteristics and design for closure; and

(iii) the non-return valve is relatively inexpensive to manufacture.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. For example, injection moulding is merely one exemplary technique of forming the non-return valves. the diaphragm may be constructed of practically any resiliently flexible material which in a collapsed condition obstructs the collapsible aperture to prevent flow across the valve or membrane. The non-return valves may extend to applications other than those described above. For example, the fail-safe non-return valve may be connected across the skin of a ships hull and provide a means of quick evacuation where the human body can slip through the dual or multiple diaphragm valves.

All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm in the form of a generally conical-shaped diaphragm having a collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction, said diaphragm being connected across the fluid passageway and being constructed of a resiliently flexible material wherein the diaphragm itself at least initiates closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

2. A non-return valve comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

at least two valve diaphragms being axially spaced along and connected across the fluid passageway, each of the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent

fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of either of the axially spaced diaphragms deflects said diaphragm to expose the corresponding aperture and allow fluid to flow through the passageway and across said diaphragm toward the fluid outlet only.

3. A non-return valve as defined in claim 1 or 2 wherein the pressure is imposed on the inlet side of the diaphragm via a fluid nozzle which is designed to be retractably received within the passageway.

4. A non-return valve as defined in claim 3 wherein the valve body is designed to fit to a reservoir or tank in which fluid is to be dispensed via the fluid nozzle.

5. A non-return valve including a bank or series of non-return valves of similar construction coupled to one another, each of said non-return valves comprising:

a valve body including a fluid passageway which defines a fluid inlet and a fluid outlet, the fluid passageway being adapted to allow a flow of fluid from the inlet to the outlet; and

a valve diaphragm being connected across the fluid passageway and including a collapsible aperture, the valve diaphragm being constructed of a resiliently flexible material and being configured wherein the diaphragm itself in a collapsed condition effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas pressure imposed on an inlet side of the diaphragm deflects the diaphragm to expose the

aperture and allow fluid to flow through the passageway from the inlet to the outlet only.

6. A non-return valve as defined in claim 5 wherein the non-return valves are coupled together with their respective valve bodies at least partly nested within one another wherein said valves are co-axially aligned.

7. A non-return valve as defined in claim 5 wherein the non-return valves are each of the same construction and configured to abut or engage one another with their valve bodies in alignment.

8. A non-return valve as defined in any one of claims 5 to 7 wherein the diaphragms are each in the form of a generally conical-shaped diaphragm having the collapsible aperture located at or adjacent its apex which is orientated in a downstream flow direction.

9. A non-return valve comprising:

a valve body including a passageway which defines an inlet and an outlet, the passageway being adapted to receive means for actuating the valve;

at least two valve diaphragms being axially spaced along and connected across the passageway, each of the diaphragms including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction toward the inlet whereas engagement of said actuating means with at least one of the diaphragms exposes its corresponding aperture and allows passage across said diaphragm toward the fluid outlet only.

10. A non-return valve as defined in claim 10 wherein said actuating means is a fluid nozzle which is retractably inserted into at least one of the collapsible apertures to permit a flow of fluid across the corresponding diaphragm via the fluid nozzle.

11. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is formed integral with the valve body.

12. A non-return valve as defined in any one of the preceding claims wherein the valve membrane is constructed of a mouldable polymeric material.

13. A non-return valve as defined in any one of the preceding claims wherein the valve body is configured to retrofit to an existing valve stem.

14. A non-return valve as defined in any one of the preceding claims wherein the valve body is designed to be sealably inserted into a flow line.

15. A membrane being permeable in one direction only, said membrane comprising a panel or blanket of collapsible diaphragms each including a collapsible aperture and being constructed of a resiliently flexible material which is configured wherein each of the diaphragms themselves effects closure of the collapsible aperture to prevent fluid flowing in a reverse direction whereas pressure imposed on an upstream side of the membrane deflects one or more of the diaphragms to expose the corresponding aperture

and allow fluid to flow across the membrane in said one direction only.

16. A membrane as defined in claim 15 wherein the membrane is multi-layered with a series of said panels or blankets formed adjacent one another.

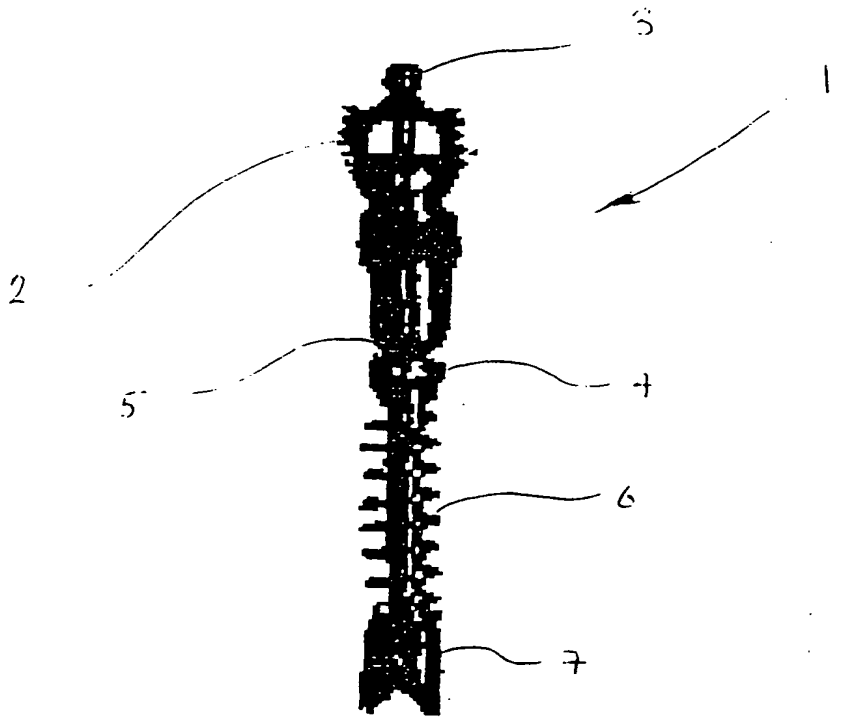


FIG. 1

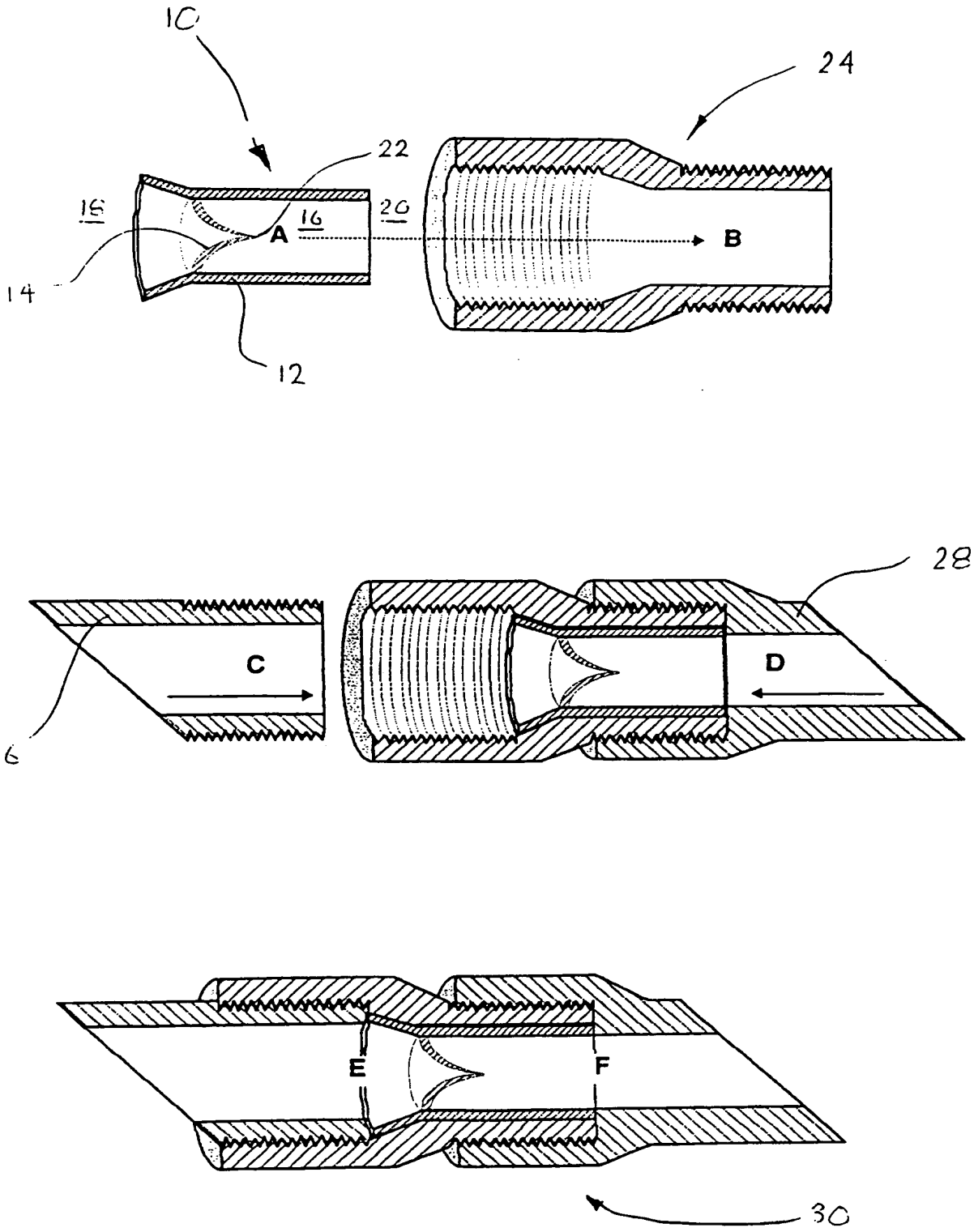


FIG. 2

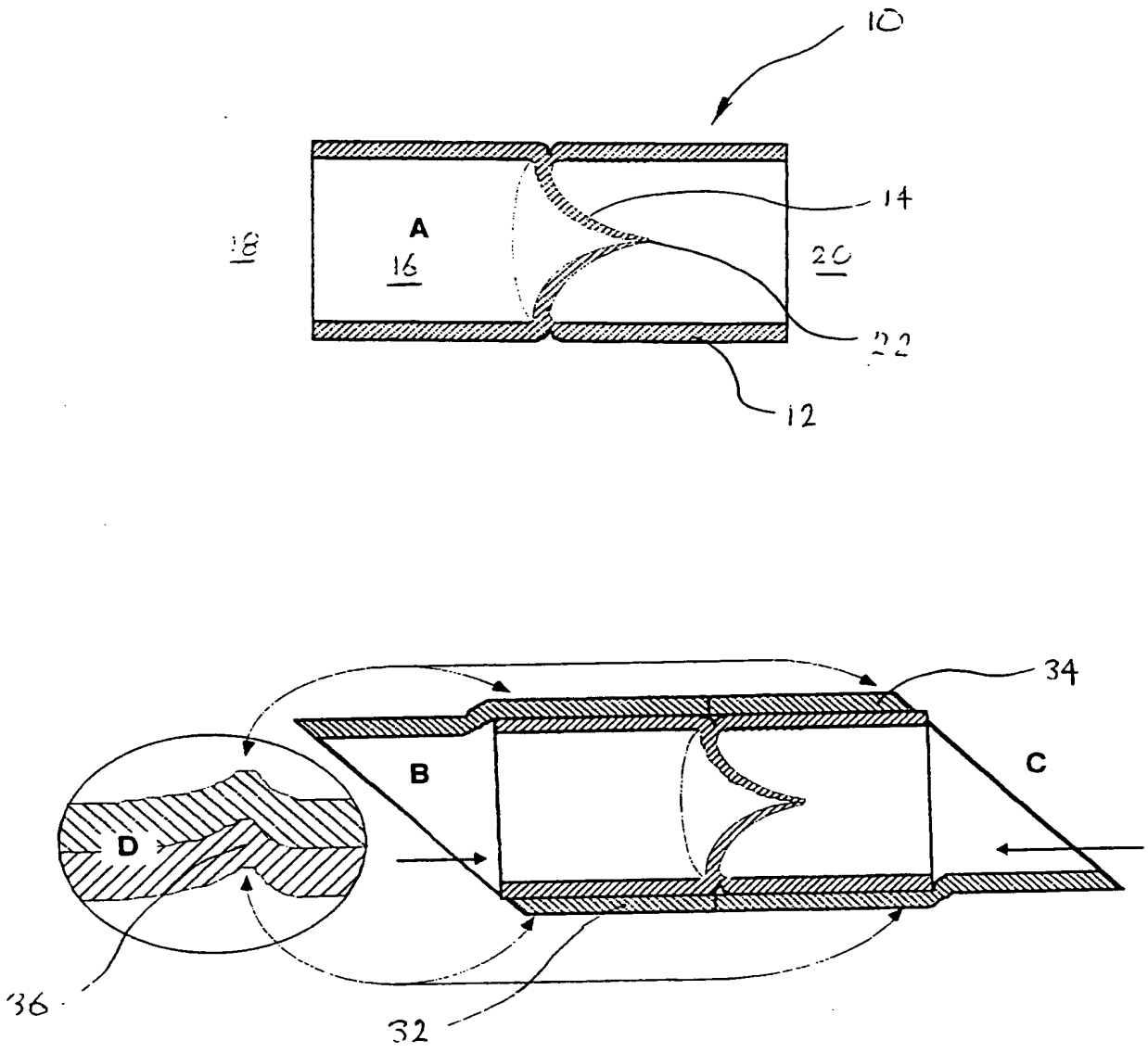
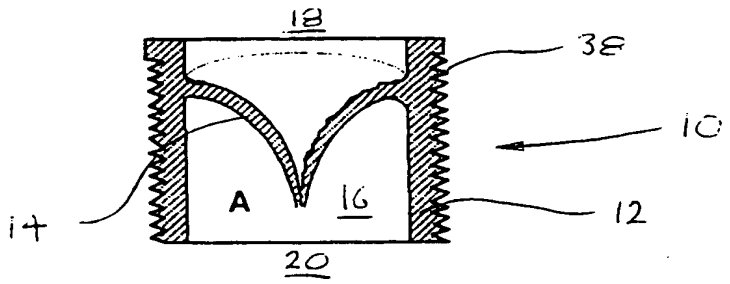


FIG. 3



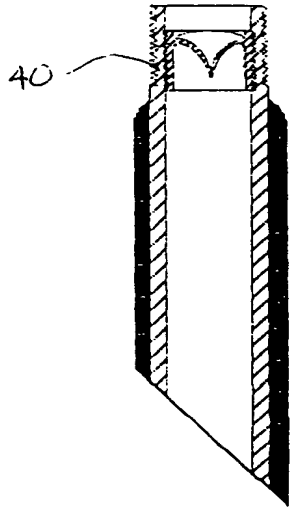
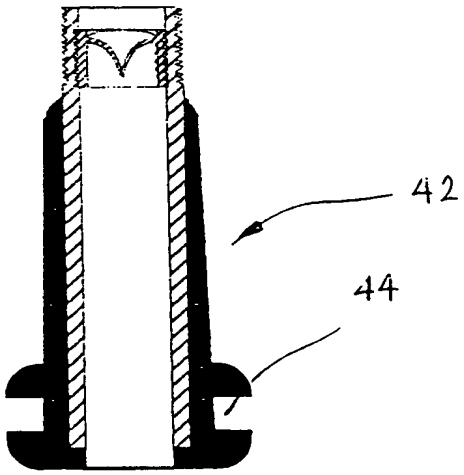


FIG. 4



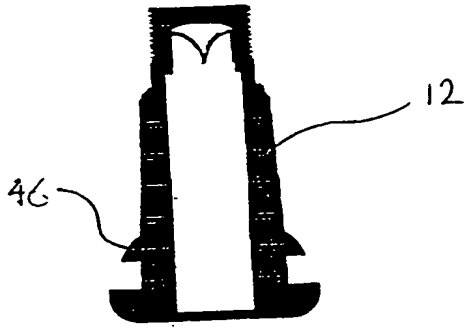


FIG. 5

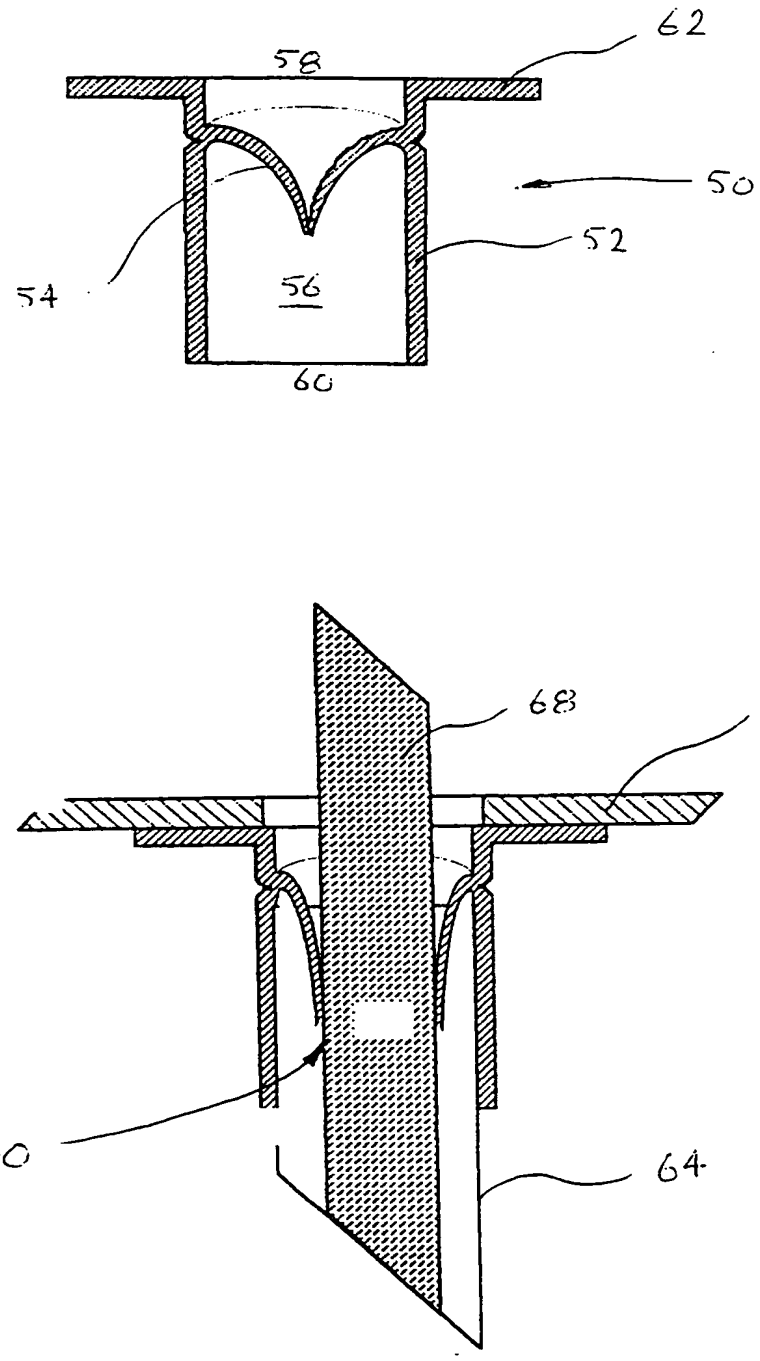
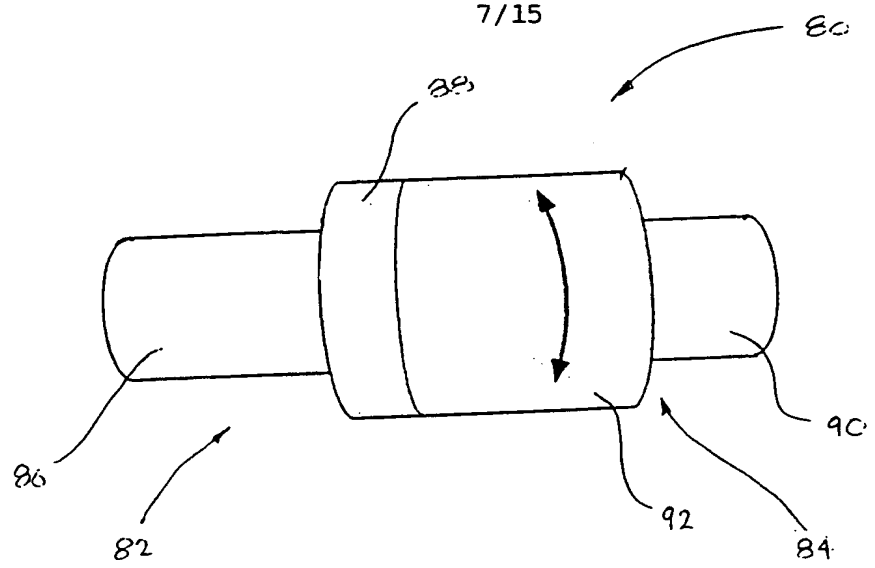
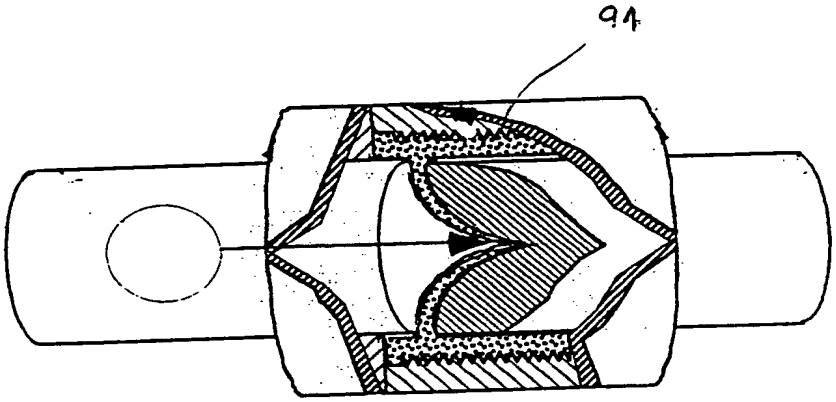


FIG. 6





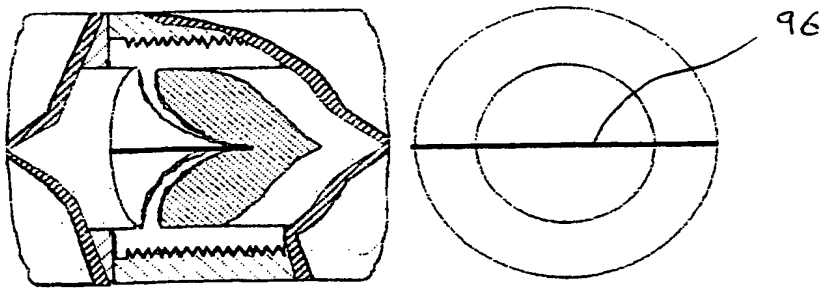


FIG. 7

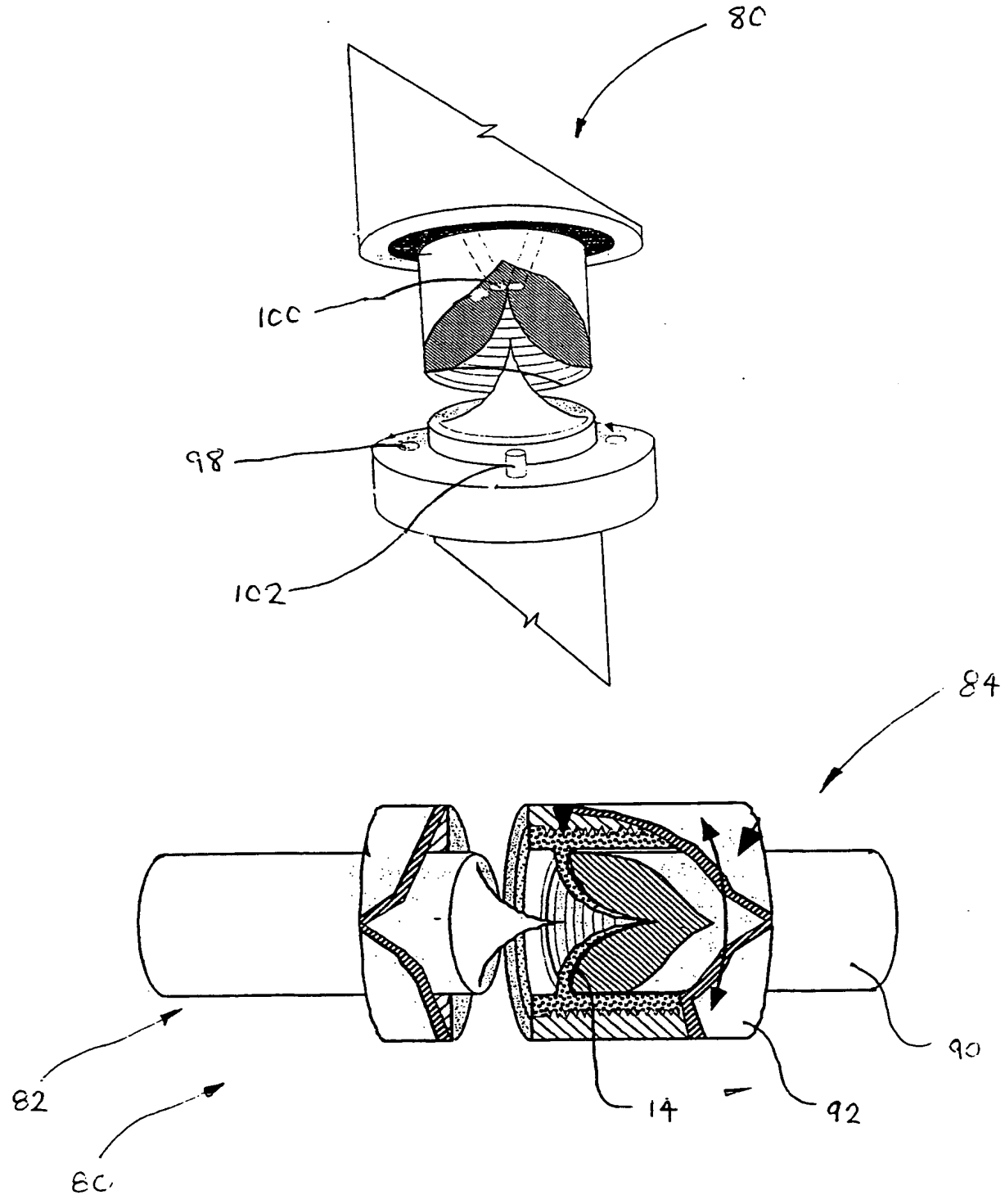


FIG. 8

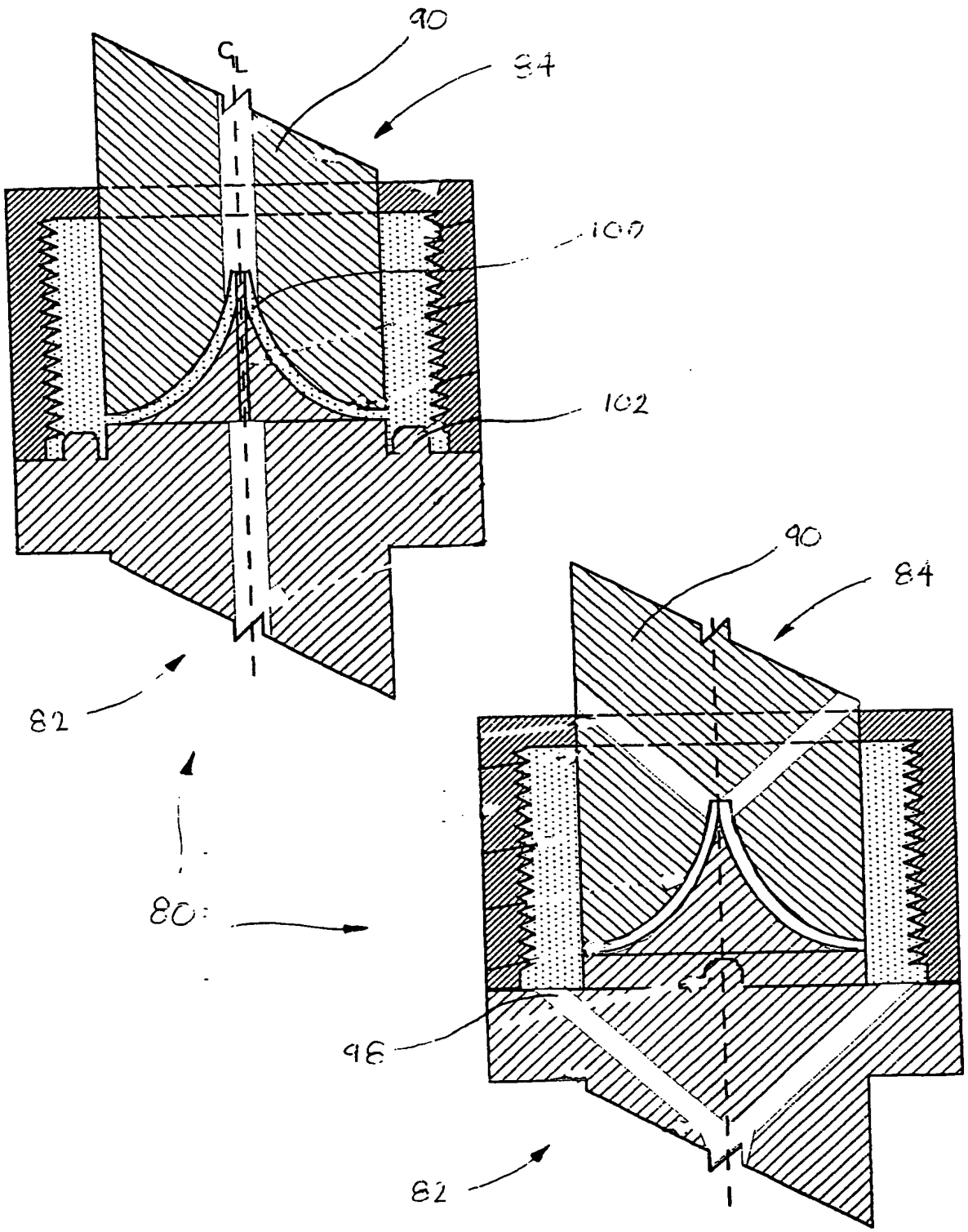


FIG. 9

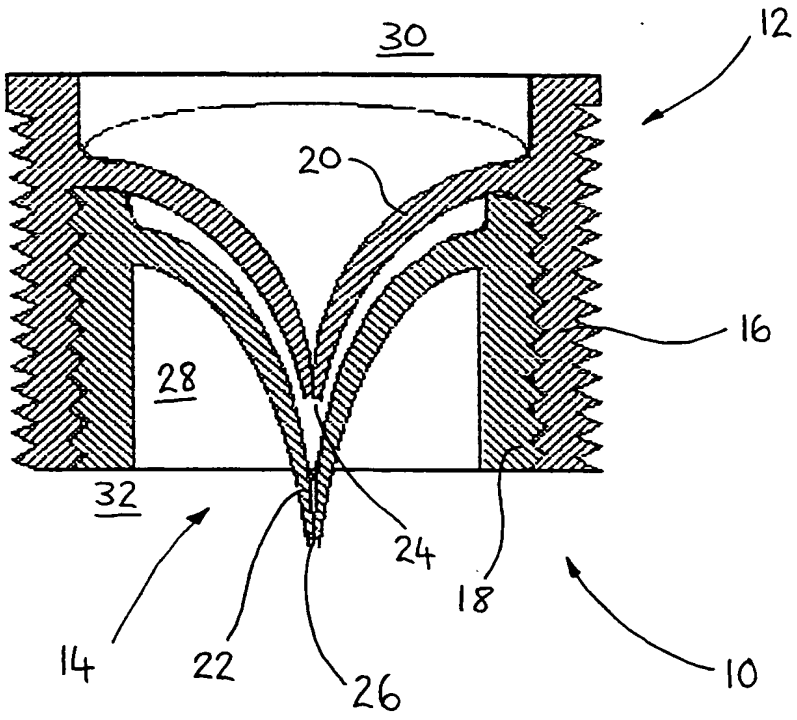


FIG. 10

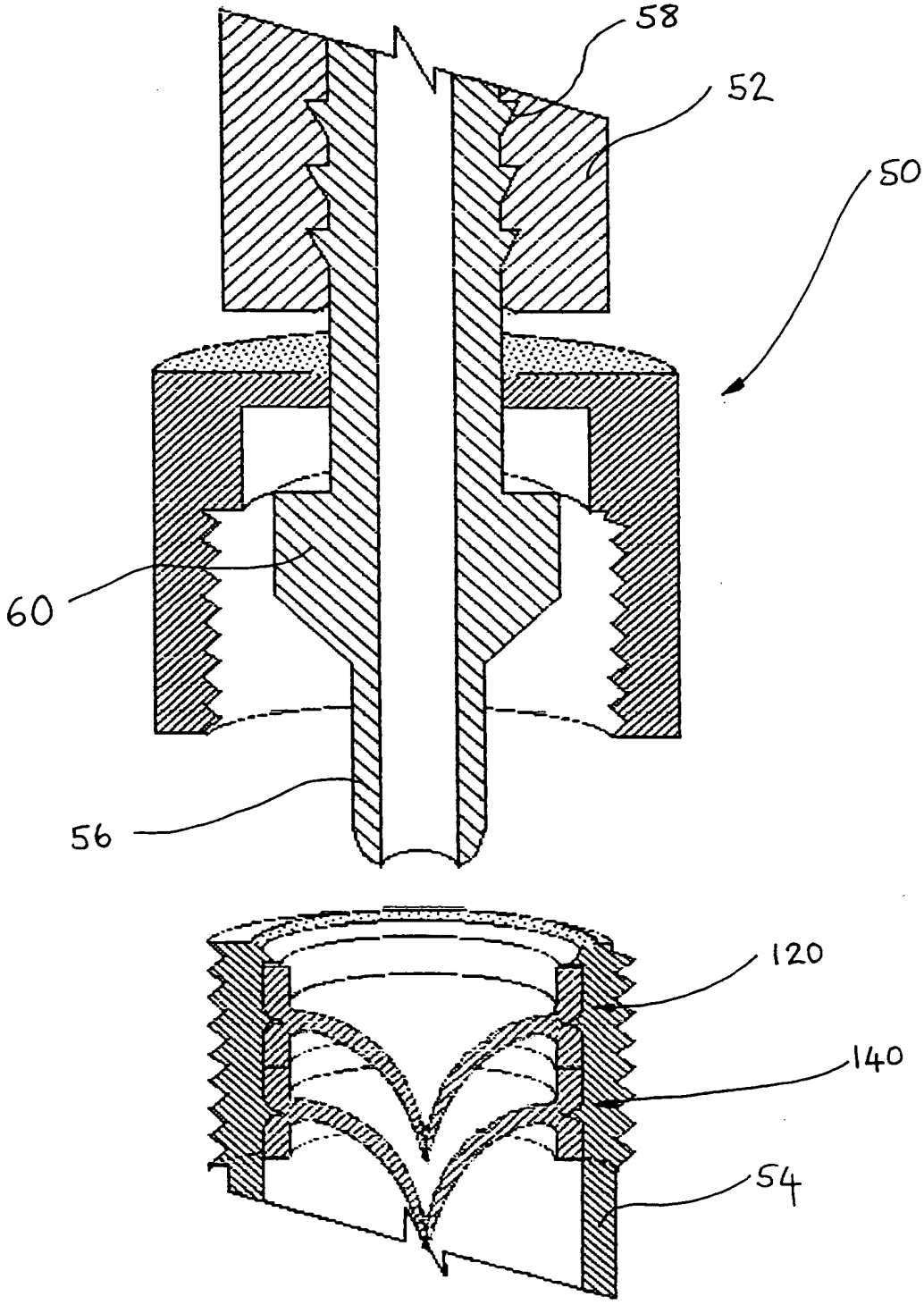


FIG. 11A

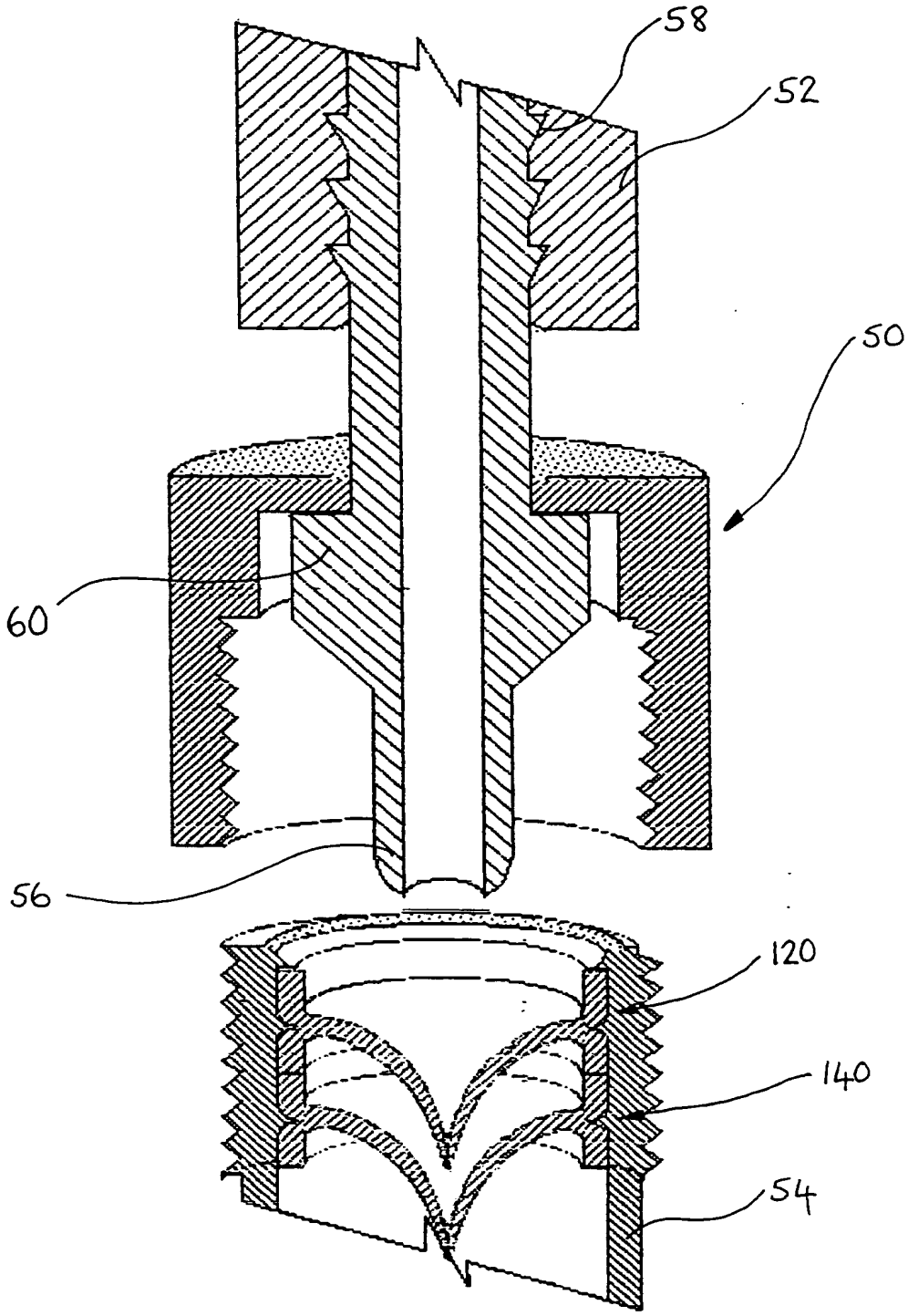


FIG. 11B

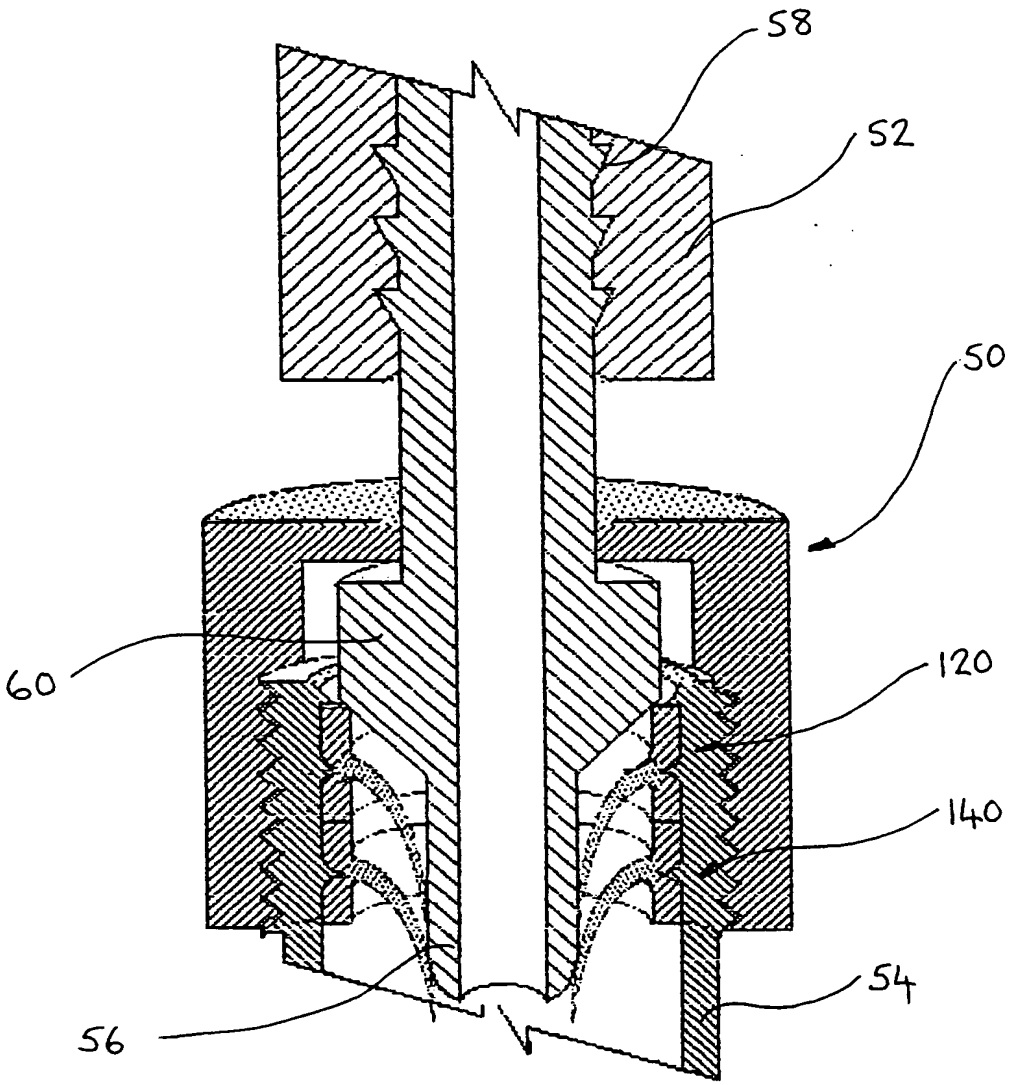


FIG. 11C

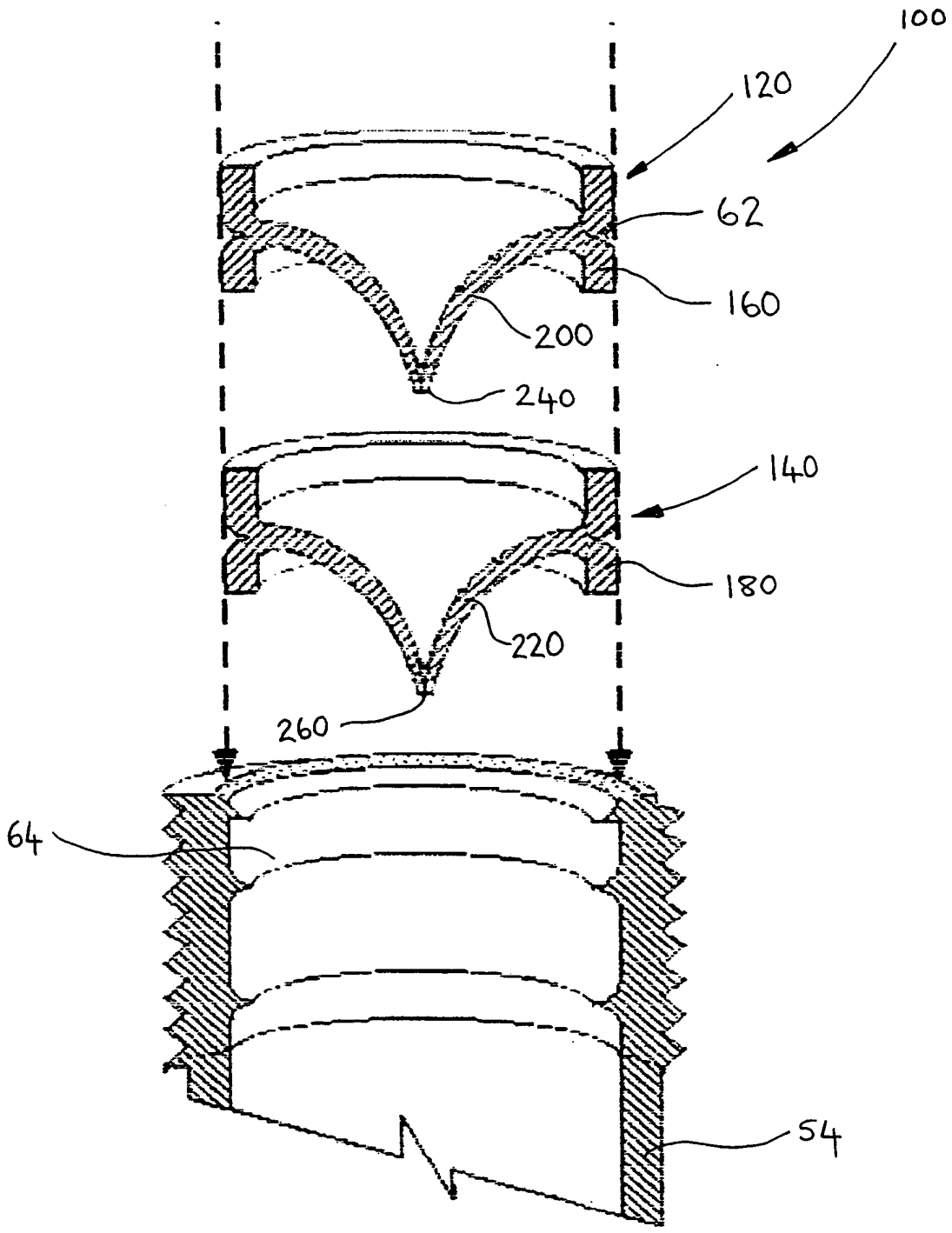


FIG. 12

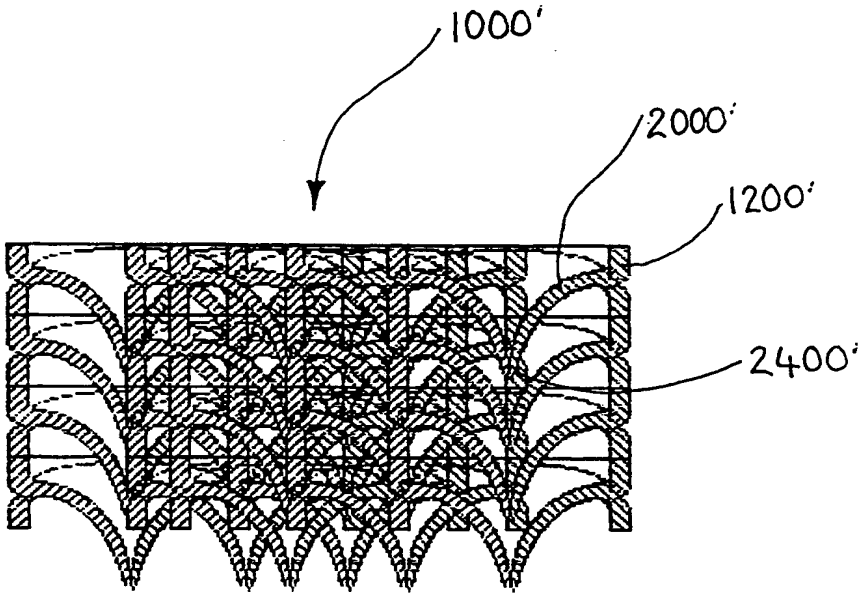


FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00659

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: F16K 15/14, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(7): F16K 15/14, 15/16, 31/126, 7/18, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 4033818 A1 (GOLDSTAR Co.) 2 May 1991 See figure 4.	1
Y	US 3822720 A (SOUZA) 9 July 1974 See figures 6A-6C.	1,2,9
Y	WO 83/02320 A1 (TAYLOR) 7 July 1983 See All figures.	1
Y	WO 98/01689 A1 (FICOTRANSPAR SA) 15 January 1998	1
Y	GB 2298027 A (GLYNWED PLASTICS Ltd) 21 August 1996	1

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 June 2000	07 JUL 2000
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **DAVID LEE** Telephone No : (02) 6283 2107

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00659

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
US	3822720	NONE	
DE	4033818	NONE	
WO	8302320	EP	96707
WO	9801689	NONE	
GB	2298027	EP	727531

END OF ANNEX

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00659

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[7]: F16K 15/14, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(7): F16K 15/14, 15/16, 31/126, 7/18, 7/02, 7/04, 7/07, B60C 29/00, B32B 3/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 4033818 A1 (GOLDSTAR Co.) 2 May 1991 See figure 4.	1
Y	US 3822720 A (SOUZA) 9 July 1974 See figures 6A-6C.	1,2,9
Y	WO 83/02320 A1 (TAYLOR) 7 July 1983 See All figures.	1
Y	WO 98/01689 A1 (FICOTRANSPAR SA) 15 January 1998	1
Y	GB 2298027 A (GLYNWED PLASTICS Ltd) 21 August 1996	1

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search
30 June 2000

Date of mailing of the international search report
07 JUL 2000

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INTERNATIONAL SEARCH REPORT
Information on patent family members

Internati nal application No.
PCT/AU00/00659

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